

Anal Sphincter Injury

Management and Results of Parks Sphincter Repair

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ACKNOWLEDGMENT

The late Sir Alan Parks had completed this review of his anal sphincter muscle repairs and the results were presented to the British Society of Gastroenterology in September 1982 (Browning GGP and Parks AG: Gut 1982; 23:A901-2). All of the operations were performed by him. The authors gratefully acknowledge the permission of Lady Parks and the Consultant Surgeons at St. Mark's Hospital to continue with this work after his untimely death and to publish this paper.

The surgical management of a consecutive series of 97 patients with complete division of the anal sphincter musculature is reported. The sphincter damage followed operative, traumatic, or obstetric injury and resulted in frank fecal incontinence or the urgent necessity of a defunctioning colostomy. All patients were treated by delayed sphincter repair using an overlapping technique; in 93 the repair was protected by a temporary defunctioning stoma. There were no deaths. The repair was completely successful in 65 (78%) and partially successful in 11 (13%) of the 83 patients assessed from 4 to 116 months after surgery. Complications occurred in 27 patients but did not usually affect the eventual clinical outcome. Provided there has been no major neurological damage to the sphincter complex, surgical reconstruction can be expected to restore continence in most patients.

DIVISION of the anal sphincters occurs as a result of traumatic injury, surgical mishap, or following obstetric tears extending into the anal canal. In most cases of trauma a colostomy is performed as part of the primary management and although these patients often have other injuries to contend with they have relatively few anal symptoms. When sphincter division follows surgical or obstetric damage the injury may not be immediately apparent. Few of these patients have a colostomy and they therefore have varying degrees of fecal incontinence. Their symptoms can lead to serious social isolation and not

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infrequently they first present for repair many years after the original injury. Division of the anal sphincters therefore presents problems in primary management, restoration of continence, and social rehabilitation. The most challenging is restoration of anal continence.

Primary repair at the time of injury is usually successful following obstetric tears limited to the anterior midline, but is not usually successful following traumatic or operative injury elsewhere in the sphincter ring. Many different secondary procedures have been described in an attempt to restore continence. These may be classified into indirect methods, where the divided sphincter is left unrepaired, and direct methods to repair the sphincter itself. Indirect techniques include construction of circumanal slings of striated muscle¹⁻⁷ or fascia,⁸⁻¹⁰ external sphincter reefing procedures¹¹ and the use of striated muscle grafts.^{12,13} Direct methods involve identification, mobilization, and suture of the ends of the divided sphincter. The earliest attempts employed an end-to-end technique,¹⁴⁻¹⁷ however, the results were disappointing largely due to cutting out of the sutures and retraction of the muscle ends. An alternative method of direct repair utilizing an overlapping technique produced good functional results.^{18,19} This paper describes the surgical management of a consecutive series of 97 patients treated between 1961 and 1982.

Technique and Patients

Operative Technique

If a colostomy is already established the distal colon and rectum is prepared by simple washthrough. In other cases the bowel is prepared as for a major colonic resection. Prophylactic antibiotics, however, are not routinely given. A temporary defunctioning colostomy²⁰ is carried

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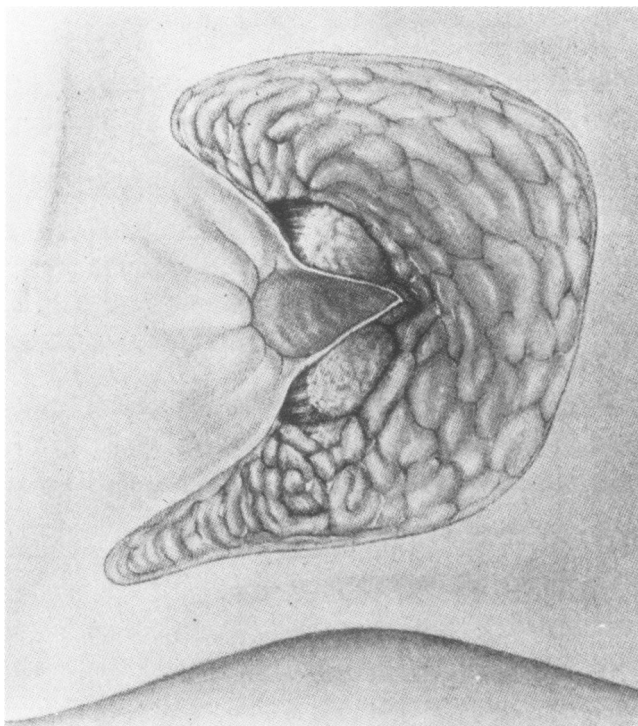


FIG. 1. Scarred perianal skin, anal epithelium, and fibrous tissue has been excised exposing ischio-rectal fat and the sphincter muscle ends. Scar tissue attached to the muscle ends is left intact. Reproduced with permission from *Operative Surgery: Colon, Rectum and Anus*. London: Butterworths, 1977: 245-248.

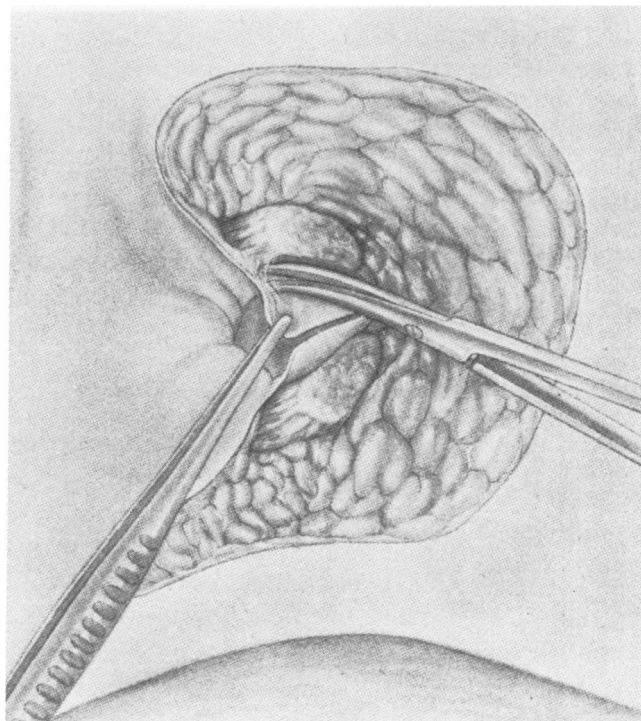


FIG. 2. Anal skin and epithelium are mobilized by sharp dissection. Reproduced with permission from *Operative Surgery: Colon, Rectum and Anus*. London: Butterworths, 1977: 245-248.

out at the time of repair; patients who refuse a stoma are given an elemental diet for 10 days after surgery.

The operation is performed under general anesthesia with the patient in the lithotomy position. Muscle relaxants are avoided so that a nerve stimulator can be used to aid identification of the external sphincter and its nerve supply. The perianal tissues are infiltrated with adrenaline in saline 1 in 300,000 and a generous circumanal incision made. The extent of the incision depends on the degree of retraction of the divided sphincter, however, it usually encompasses at least half the anal circumference. Scarred skin and any residual fistula are excised exposing ischio-rectal fat; the ends of the divided sphincter are not seen at this stage though fibrous tissue between them is usually obvious. When this is excised the sphincter muscle ends are seen in the base of the wound (Fig. 1). No attempt is made to remove attached fibrous tissue since this holds sutures better than bare muscle. The anal skin and epithelium are separated from the inner aspect of the sphincter (Fig. 2) and repaired reconstructing the anal mucosal tube (Fig. 3). The sphincter muscle ends are then freed from ischio-rectal fat and fibrous adhesions by sharp dissection (Fig. 4). Care is required to ensure sufficient mobilization for a repair without tension at the same time preserving the blood and nerve supply to the muscle. The nerve stimulator is useful at this stage. More mobility can be obtained by dividing the attachment of the sphincter complex to the coccyx allowing the whole sphincter mass to ride forwards. The ends of the external sphincter and, in the case of posterolateral injuries, the puborectalis are now overlapped creating a snugly closed anal canal; this is done in some depth to restore anal canal length. Provided there is no excessive tension the overlap cannot appear too tight. The repair is performed with two layers of monofilament stainless steel wire or polyglycolic acid horizontal mattress sutures passed through the whole thickness of the overlapped muscle ends (Fig. 5). The free edge of the anal mucosa is then sutured to the lower edge of the muscle repair with catgut. A silicone sheet, cut to the shape of the wound and sutured in place with catgut, aids drainage of serous exudate, prevents dressings adhering to the granulation tissue and facilitates inspection of the wound in the first few days. The wound is irrigated twice daily and after 4 to 5 days the patient bathes twice daily. The silicone usually separates at this time and thereafter gauze dressings are used. The wound heals by granulation, rapidly decreasing in size and is normally healed in from 6 to 8 weeks. The colostomy is closed from 2 to 3 months later.

Patients

Ninety-seven patients, 57 women and 40 men aged 4 to 74 years (mean 38 years), underwent operation. All

had sustained complete division of the anal musculature resulting in frank fecal incontinence or the urgent necessity of a colostomy.

The etiology of the sphincter injuries is shown in Fig. 6 and the age of the patients in Table 1. In 58 patients (60%) the sphincter damage was the result of an anal operation. Fifty-two (F33, M19) followed surgery for fistula; 35 (67%) had had two or more previous operations, and in six (F5, M1) the fistula was associated with Crohn's disease. Four patients (F1, M3) became incontinent following anal dilatation and two (F1, M1) had a segment of sphincter removed at the time of local excision of anal carcinoma. Trauma occurred in 26 patients (27%). The mean age was considerably younger in women (range 4–18 years) than men (range 8–57 years, Table 1). Seventeen (F9, M8) were involved in major road accidents; among these six (F2, M4) were motorcyclists, four (F3, M1) sustained traumatic hindquarter amputations, and five (F3, M2) a crushed pelvis. The remaining nine traumatic injuries, all in men, were the result of falls on the perineum. In 13 patients (13%) the sphincter damage occurred during childbirth. The injuries were all recognized and repaired after delivery, however, anal symptoms rapidly developed in these patients. Four also had complicated deliveries and may have sustained additional traction injuries of the pudendal nerves.

The primary management had been carried out without a colostomy in 64 patients (66%, Table 2). These patients, predominantly women with operative and obstetric injuries, consequently suffered fecal incontinence. The remaining 33 patients (34%), mostly men but including eight of the nine women with traumatic injuries, had been given defunctioning colostomies. Twenty-four primary or secondary sphincter repairs (11 without a colostomy, 13 with a colostomy) had been previously attempted, however, none was successful.

The symptoms and signs are shown in Table 3. Incontinence was not only more common in women but was also of longer duration (women 11.1 ± 1.5 years, men 7 ± 1 years, mean \pm SEM; $p < 0.05$, chi square test) due to their delay in presentation with operative and obstetric injuries (Table 1). Patients with a colostomy were not entirely symptom-free, experiencing considerable uncontrolled mucus discharge. The important physical signs were a gaping anal canal, perianal scarring, and a palpable defect in the sphincter muscle ring; one or more of these signs was present in all 97 patients. The majority also underwent manometric and electromyographic investigation; the results will be reported elsewhere.

Details of the sphincter muscle damage (Table 4) were determined from the clinical, electromyographic, and operative findings. Fifty-one patients (53%) had anterior division of the external sphincter only; these accounted for all the obstetric and approximately one-half the op-

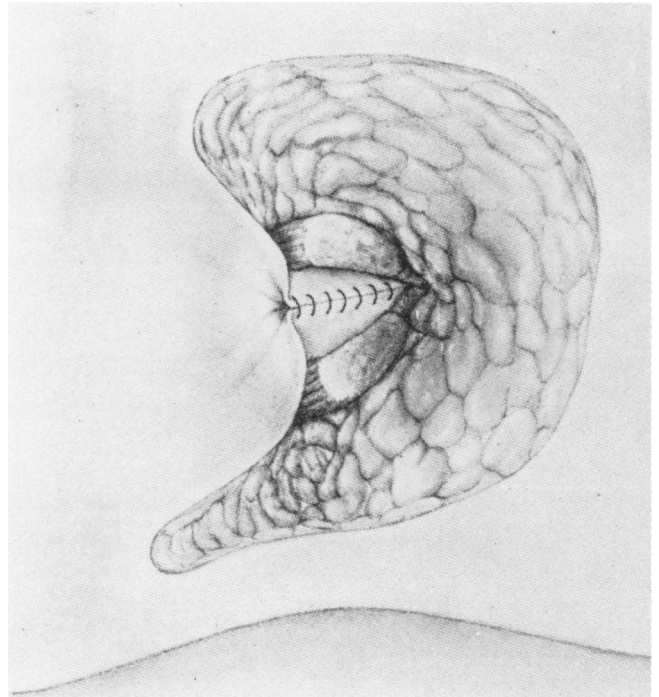


FIG. 3. Reconstruction of the anal mucosal tube is carried out with continuous 2/0 chromic catgut taking small, carefully placed bites to obviate fistula formation. Reproduced with permission from *Operative Surgery: Colon, Rectum and Anus*. London: Butterworths, 1977: 245–248.

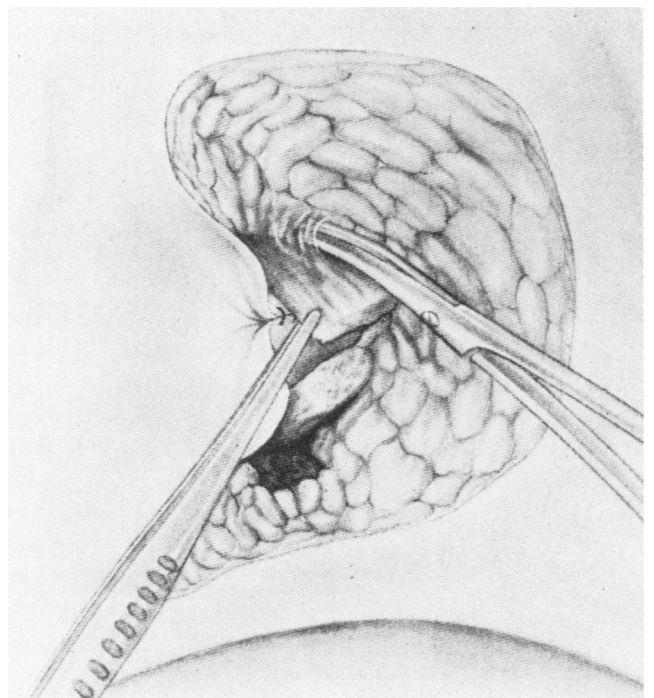


FIG. 4. Mobilization of the sphincter muscle ends by sharp dissection. Reproduced with permission from *Operative Surgery: Colon, Rectum and Anus*. London: Butterworths, 1977: 245–248.

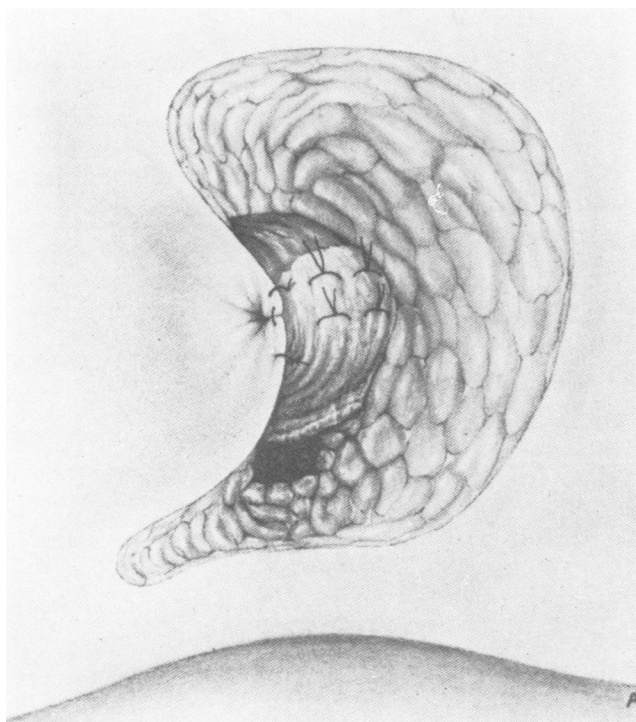


FIG. 5. The completed repair is shown. The anal canal is snugly closed and some anal length has been restored. The wound is left open to heal by granulation. Reproduced with permission from *Operative Surgery: Colon, Rectum and Anus*. London: Butterworths, 1977: 245-248.

erative and traumatic injuries. Forty-six patients (47%) had injury of both the puborectalis and external sphincter. Thirty-seven (F13, M24) of these were simple divisions (in one woman multiple sites were involved), most commonly following operative injury in the posterior or lateral

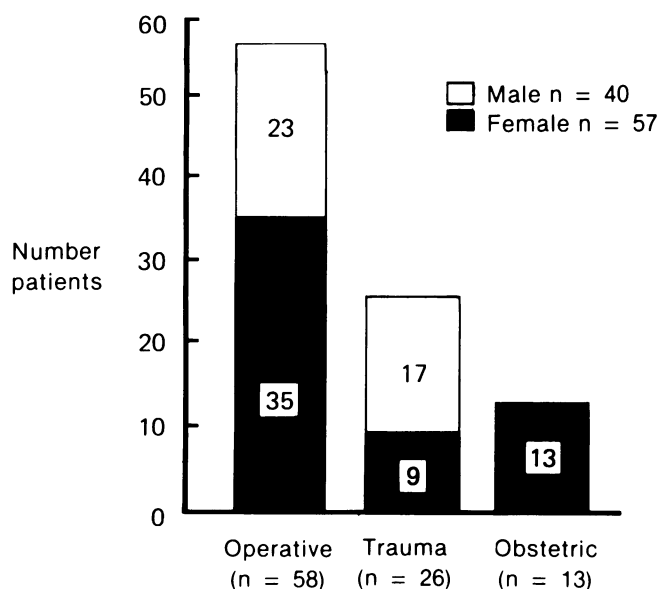


FIG. 6. Histogram illustrating the etiology of the sphincter injuries.

TABLE 1. Age at Time of Anal Sphincter Muscle Injury, Age at Time of Anal Sphincter Muscle Repair, and Time Elapsed Until Repair (Years)

	Operative Injury (N = 58)		Trauma (N = 26)		Obstetric Injury (N = 13)
	F35	M23	F9	M17	F13
At injury	36 ± 3	41 ± 4	12 ± 2	30 ± 3	32 ± 2
At repair	46 ± 3	45 ± 4	14 ± 6	35 ± 4	48 ± 3
Time to repair	10 ± 2	4 ± 2	2 ± 0.6	5 ± 2	16 ± 3

All values mean ± SEM.

quadrants. The remaining nine patients (F6, M3) had total disruption of the entire sphincter complex due to major pelvic trauma. This resulted in either avulsion of one-half of the levator ani, puborectalis, and external sphincter (F3, M2), or an injury consisting of section of the puborectalis and external sphincter in the posterior midline combined with anterior division of the external sphincter (F3, M1). Retraction of the muscle ends to 180° occurred in 53 patients (55%).

Standard overlapping muscle repairs (74 stainless steel wire, 23 polyglycolic acid) were carried out in all patients; supplementary procedures were included when indicated. Separation of the sphincter complex from the coccyx was employed in 37 patients, most frequently during posterolateral repairs. Postanal repair was added in seven patients: these had severe anterior deficiency of the external sphincter (treated by overlapping sphincter repair) combined with either division of both the puborectalis and external sphincter in the posterior midline or electromyographic evidence²¹ or neuropathic change in the pelvic floor musculature. Anterior opposition of the limbs of the puborectalis was performed in five patients to obtain additional closure of the anal canal. All the repairs were carried out with the protection of a temporary defunctioning colostomy or ileostomy except in four patients who refused a stoma; two of these were managed with an elemental diet after surgery.

Results

Operative Complications

There was no postoperative death. Specific complications requiring definitive operative treatment occurred in 27 patients (Table 5). The repair broke down on four occasions. In two women this was due to muscle necrosis; both underwent immediate revision of the repair which was successful in one. The remaining two breakdowns were the result of mechanical disruption in patients who had refused a temporary colostomy. Fistulae occurred in seven patients and delayed closure of colostomy in all of them; spontaneous healing occurred in four, excision was

TABLE 2. *Primary Management of Anal Sphincter Muscle Injuries*

	Operative Injury (N = 58)		Trauma (N = 26)		Obstetric Injury (N = 13)
	F35	M23	F9	M17	F13
No defunctioning colostomy (N = 64)	32	14	1	4	13
Defunctioning colostomy (N = 33)	3	9	8	13	—

successful in one, one failed to heal, and one is under review. Ten of the 16 patients who developed a stricture required operative dilatation which delayed colostomy closure; the remainder resolved following outpatient treatment with an anal dilator. Wound sinuses healed rapidly after offending wire sutures were removed. Delayed healing (>4 months) was treated by skin grafting in two patients.

Functional Results

Postoperative function has been determined in 83 patients (Tables 6 and 7) from 4 to 116 months (mean 39.2 months) after either closure of the colostomy or the repair itself if performed without a temporary stoma. Sixty-five patients (78%) regained completely normal continence for solid and liquid stool; none of these had fecal leakage but some had minor problems with flatus. Eleven patients (13%) had partial return of function with generally acceptable continence for solid stool but poor control over liquid stool and flatus; these patients reported intermittent fecal leakage. In the remaining seven patients (9%) the repair was judged to have failed. In the operative group (Table 6) one woman had a successful second repair 2 years later and became continent of solid stool; one woman with Crohn's disease refused a colostomy both at the time of the repair and after the repair had failed; and two (F1, M1) have permanent colostomies. One of these refused a temporary colostomy to protect the repair and in the other revision of the repair following muscle necrosis was unsuccessful. In the trauma group one patient with an intractable fistula has a permanent colostomy. Both failures in the obstetric group have subsequently been shown to have pelvic floor neuropathy on single fiber electromyography;²¹ one has a permanent colostomy but the other has chosen to remain with a poor functional result.

Table 7 shows the functional results according to the sex of the patients and the sites of the sphincter division. In the women all five failed repairs and four of the seven partially successful results occurred following repair of the anterior quadrant. In contrast in the men both failures and all the poor results were associated with repair of the posterolateral quadrants of the sphincter ring.

TABLE 3. *Symptoms and Signs in Patients with Anal Sphincter Muscle Division*

	Women (N = 57)	Men (N = 40)
Symptoms		
Patients without colostomy (N = 64)	46	18
Faecal incontinence	46	18
Mucous discharge	27	7
Anal pad	15	4
Mucosal prolapse	3	3
Chronic anal pain	3	3
Patients with colostomy (N = 33)	11	22
Mucous discharge	8	13
Anal pad	6	1
Mucosal prolapse	1	1
Signs		
Gaping anal canal	52	37
Palpable sphincter defect	51	32
Perianal scar	44	32
Mucosal prolapse	8	9
Fistula	11	3
Absent clinical anal reflex	11	2
Reduced perineal sensation	4	3

Discussion

The external group of striated sphincter muscles, the external anal sphincter and puborectalis, make an important contribution to the maintenance of fecal continence. Although skeletal muscles and somatic in origin, they exhibit continuous tonic activity, constantly contracting both at rest and during sleep.²² Furthermore, by means of a spinal reflex, automatic contraction or relaxation occurs in response to changes in intra-abdominal pressure, posture, or movement.²³ In addition, the forward pull of the puborectalis produces a right angle between the rectum and anal canal creating a flap valve mechanism.²⁴ Any rise in intra-abdominal pressure not only causes reflex contraction of the puborectalis accentuating the anorectal angle but also forces the anterior rectal wall into the upper anal canal creating an effective seal. The mechanism is dependant on the presence of an intact external sphincter anteriorly; if this is deficient there is no supporting tissue on which the rectal wall can descend

TABLE 4. *Details of Anal Sphincter Muscle Damage*

	Operative Injury (N = 58)		Trauma (N = 26)		Obstetric Injury (N = 13)
	F35	M23	F9	M17	F13
Anterior division of EAS only	22	6	3	7	13
Posterolateral division of PR and EAS	13	17	6	10	—

EAS = external anal sphincter muscle; PR = puborectalis muscle.

TABLE 5. *Complications Following Anal Sphincter Muscle Repair*

	Women (N = 57)	Men (N = 40)
Breakdown of the repair*	3 (2)	1
Fistula	3 (1)	4 (2)
Stricture	9 (4)	7 (6)
Sinus	8 (7)	8 (6)
Delayed healing	7 (1)	2 (1)

* Two patients refused a temporary colostomy.

Figures in brackets indicate numbers who underwent operative treatment of the complication: some patients had more than one complication.

to seal the anal canal. Thus in normal subjects complete division of the puborectalis and external sphincter posterolaterally or the external sphincter alone anteriorly results in incontinence.

Indirect methods of restoring continence after sphincter division include construction of accessory sphincteric mechanisms and procedures to augment existing function in the damaged sphincter muscle itself. Examples of the former are circumanal slings of gluteus maximus,^{1,2} pu-

bococcygeus,³ gracilis,^{4,7} adductor longus,⁵ superficial transverse perinei,⁶ and fascia lata attached to gluteus maximus.⁸⁻¹⁰ All but one of these muscles are inactive at rest.²³ Continence is achieved by conscious voluntary effort which is difficult for prolonged periods and impossible during sleep. Sporadic reports of satisfactory results are confined largely to selected young patients who can successfully reeducate their muscles.^{2,7,10} The augmentation techniques include reefing procedures designed to shorten the arc of action of the remaining external sphincter¹¹ and the use of pedicled¹² and free¹³ muscle grafts in an attempt to supplement external sphincter contractile activity. In all these procedures the defect in the muscle ring is left untreated and this probably contributes to the relatively poor functional results obtained with these methods.

The results of direct repair of the divided sphincter by end-to-end suture are unpredictable with failure rates in excess of 40%.¹⁴ The technique must overcome the inherent tone in the external sphincter which tends to cause retraction of the muscle ends and disruption of the suture line. Many different operative maneuvers have been used in an attempt to prevent muscle retraction¹⁵⁻¹⁷ but few have met with success.

It would seem, therefore, that for a successful repair, muscle of pelvic floor origin must be used and problems of retraction surmounted. In the present repair the tonically active external sphincter is used, the aim being to reconstruct a sphincter that is anatomically and physiologically as normal as possible. The overlapping technique provides a greater area of contact between the repaired muscle ends aiding firm fibrous union; moreover, a degree of retraction can occur without complete disruption of the reconstructed sphincter ring. Early experience with this repair¹⁸ suggested that the best results were obtained when it was protected by a defunctioning colostomy. In this series breakdown of the repair occurred in two of the four patients who refused a temporary stoma.

It is interesting that the most extreme degrees of trauma had occurred in the youngest female patients. This was mainly due to their involvement in serious road accidents with a high incidence of multiple injuries and major pelvic disruptions; in these cases the sphincter damage was recognized immediately and a colostomy performed. In contrast the initial treatment in women with operative or obstetric injuries usually did not include a colostomy. The delay in presentation for repair in these groups was probably related to failure to recognize the sphincter damage at the time of injury, reluctance and embarrassment in seeking treatment for a condition of this nature, and lack of awareness that effective treatment could be obtained.

TABLE 6. *Functional Results Following Anal Sphincter Muscle Repair*

	Operative Injury (N = 58)		Trauma (N = 26)		Obstetric Injury (N = 13)
	F35	M23	F9	M17	F13
Continent of solid and liquid stool; no fecal leakage	16	13	9	16	11
Continent of solid stool only; intermittent fecal leakage	7	4	—	—	—
Incontinent of all stool or permanent colostomy	3	1	—	1	2
Not assessed*	9	5	—	—	—

* One patient (F1) died of a stroke 7 months after repair before closure of colostomy, eight (F5, M3) await closure, and five (F3, M2) are lost to follow-up.

TABLE 7. *Functional Results Following Anal Sphincter Muscle Repair According to the Site of Division of the Sphincter Muscle Ring**

	Anterior (N = 51)		Posterolateral (N = 41)	
	F38	M13	F15	M26
Continent of solid and liquid stool; no fecal leakage	24	11	8	17
Continent of solid stool only; intermittent fecal leakage	4	—	3	4
Incontinent of all stool or permanent colostomy	5	—	—	2
Not assessed	5	2	4	3

* Excludes five patients (F4, M1) with combined anterior and posterolateral sphincter divisions.

The site of injury in the sphincter ring showed an interesting sex distribution. Anterior injury sufficient to cause incontinence was three times more common in women than men, a feature which has been noted previously.¹⁴ The most likely explanation for the vulnerability of the anterior quadrant in women is the smaller perineal body and attenuation of the supporting tissues following stretching of the perineum during childbirth. It would seem that the female pelvic floor is particularly susceptible to muscle and nerve damage, incontinence following a degree of injury that would not cause symptoms in the male.

As might be expected the best results were obtained in young patients with traumatic division of previously healthy normal sphincters. In the obstetric group the most likely cause of failure is pelvic floor neuropathy. This may be the result of unrecognized traction injuries to the pudendal nerves,²⁵ however, it is also more common with increasing age.²⁶ Thus delay in presentation may allow the development of neuropathy before surgical repair is undertaken. The greatest difficulty in achieving a successful result was in the operative injury group. Factors contributing to this included multiple previous anal operations, preexisting Crohn's disease, and refusal to have a temporary colostomy at the time of the repair. In addition it is possible that treatment of the original injury without a defunctioning colostomy and delay in presentation for repair affected the clinical result.

Potentially the most serious complications are ischemic necrosis and fistula. The risk of these can be minimized by careful attention to operative technique. Every effort is made to preserve the blood supply during mobilization of the muscle ends and avoid strangulation when tying the sutures. Fistulae usually originate from a defect in the reconstructed anal mucosal tube particularly at the apex of the divided mucosa. Minor complications were relatively frequent; however, all were easily treated and none affected the eventual clinical outcome. The incidence of sinus was markedly reduced in the polyglycolic acid repairs.

In the past considerable pessimism has been expressed regarding the results of reconstructive surgery following anal sphincter division particularly when the defect involved the puborectalis in the posterior or lateral quadrants. These results show that provided there has been no major neurological damage to the sphincter complex a satisfactory result can be obtained in most patients.

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